The Reactivity Limit for Methanol Oxidation on Platinum/Ruthenium Catalysts

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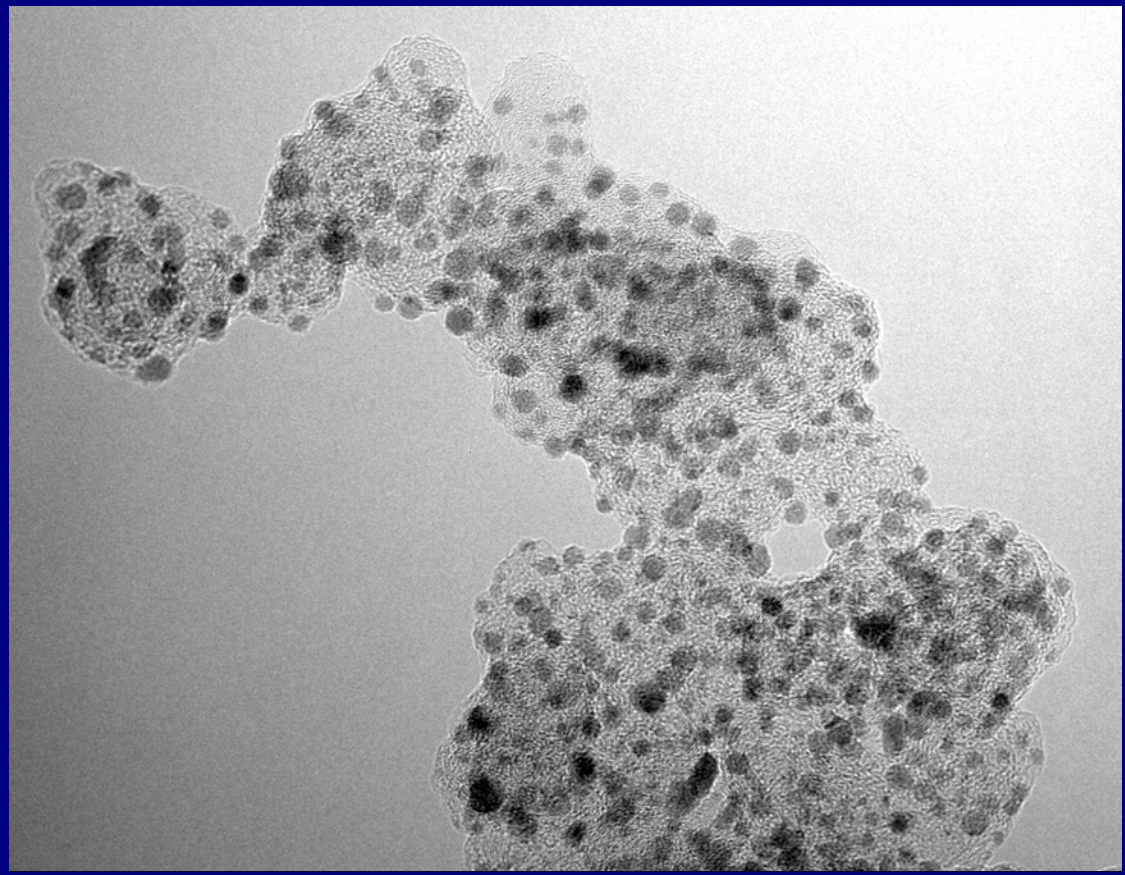
Typical references:

- A. Wieckowski, E. Savinova and C. Vayenas, "*Catalysis and Electrocatalysis at Nanoparticle Surfaces*", M. Dekker Inc., N. York, Basel, **2003** (ISBN: 0-8247-0879-2), pp. 1-970.
- *J. Catal., priority comm.*, **203**, 1 (2001).
- *J. Am. Chem. Soc.*, **124**, 468 (2002).

Drive:

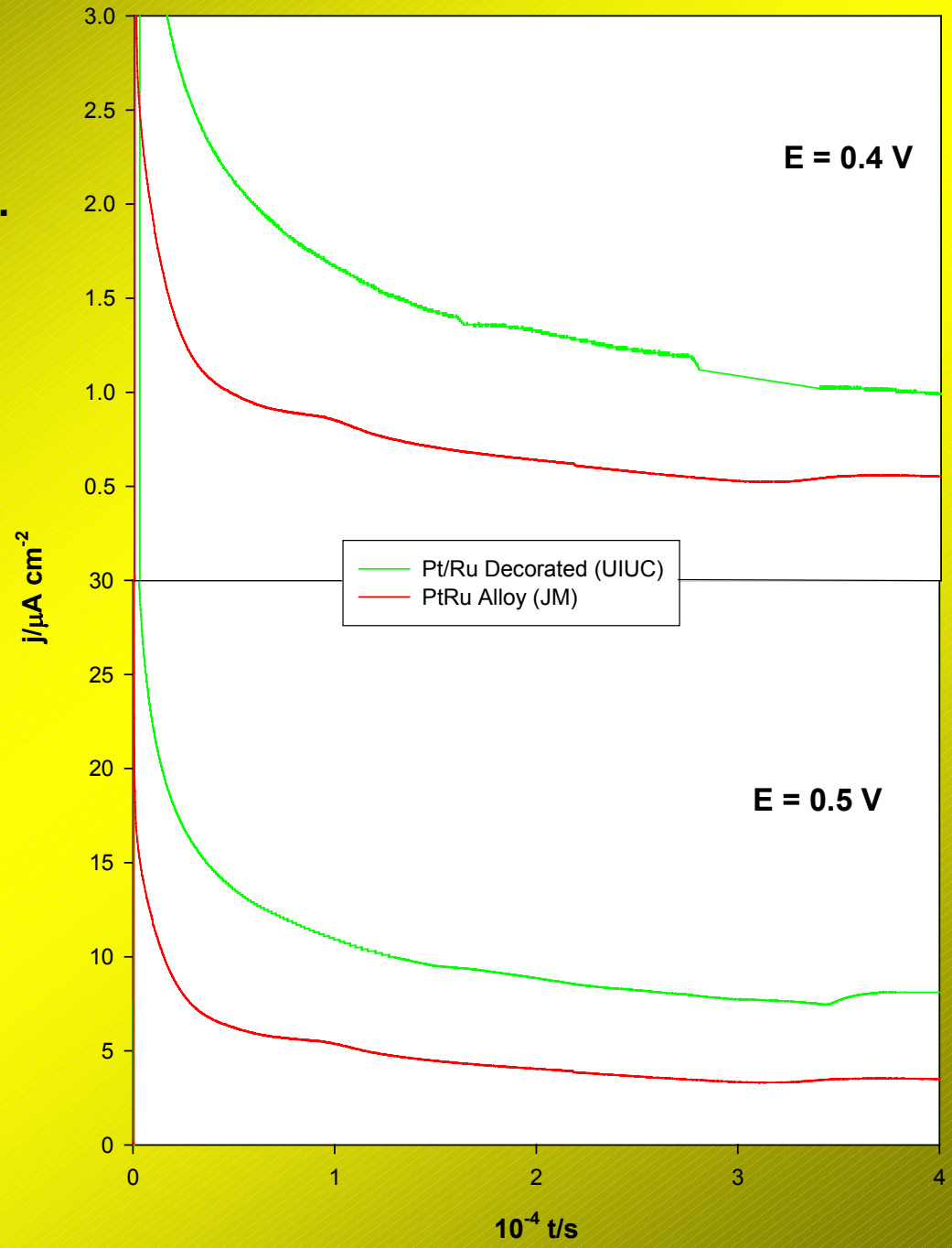
- To understand how bimetallic (ternary?) catalysts work for small organic fuel cell electrooxidation
- To synthesize active, robust, low noble metal load catalysts of high CO tolerance and reactivity
- Improvement of performance of fuel cell (DMFC, DFAFC and reformate)
- Synthetic strategy; **spontaneous deposition**
- Supported and unsupported nanoparticles, single crystals

Spontaneous Deposition of Submonolayers of Ru on **Carbon Supported** Pt Nanoparticles



TEM Image of Platinum nanoparticles (2.5 nm) on Vulcanized Carbon Support

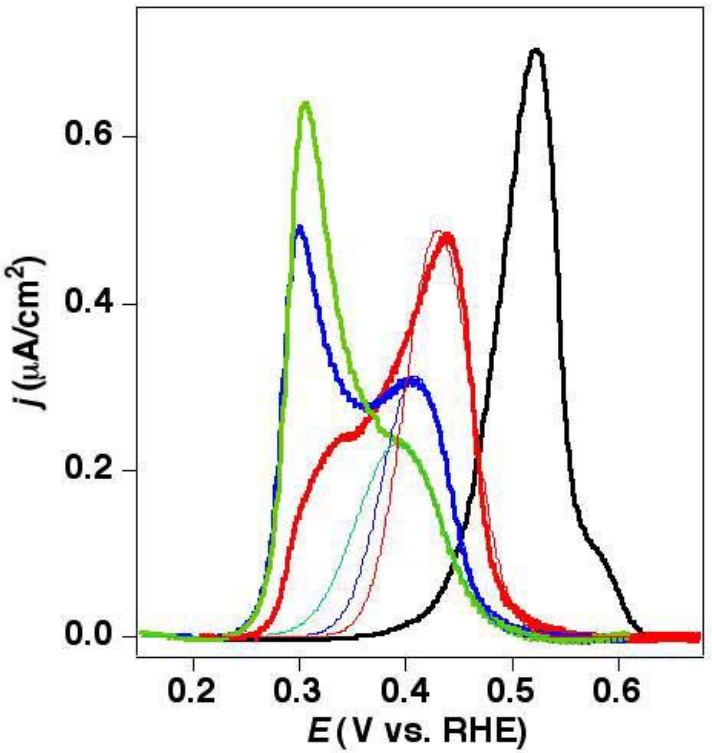
Reactivity of the Ru Decorated Unsupported Pt Catalyst vs. 2.5 nm JM HiSPEC 50:50 Pt/Ru alloy catalyst



Oxidation
in 0.5 M Methanol Solution
in 0.5 M H_2SO_4
Supporting Electrolyte

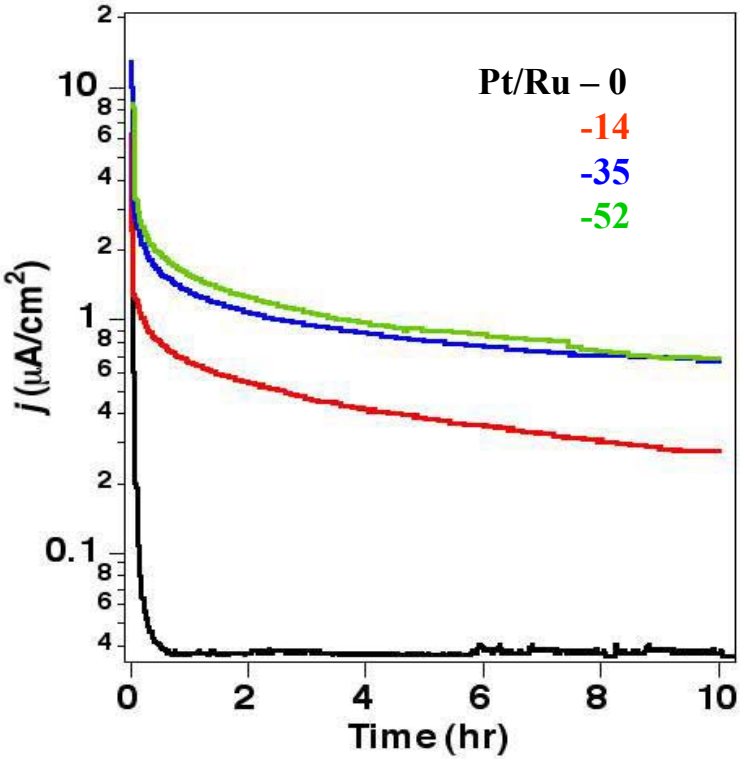
Enhancement in CO Tolerance by spontaneously deposited Ru onto unsupported Pt surfaces

CO stripping of CO ex MeOH



Significant potential shift

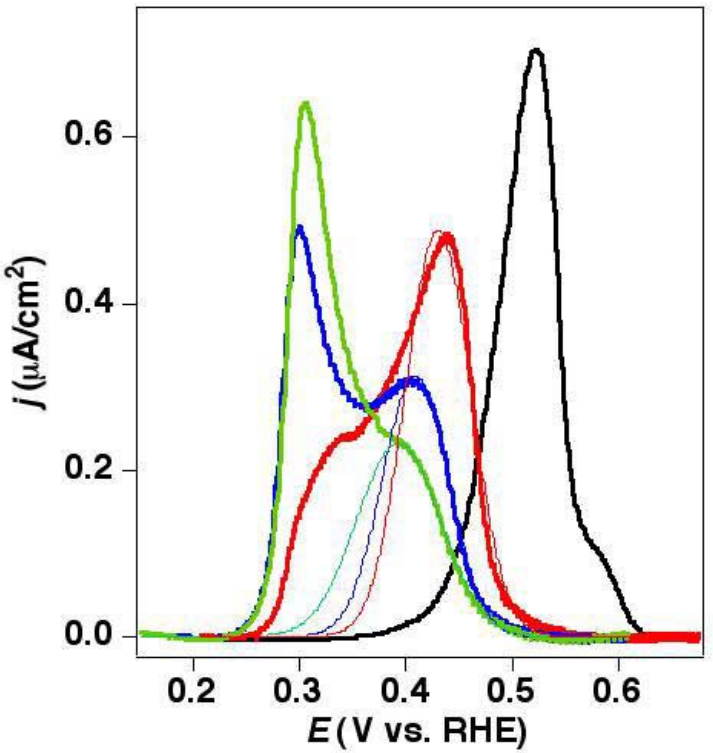
MeOH Electrooxidation (at 0.3V)



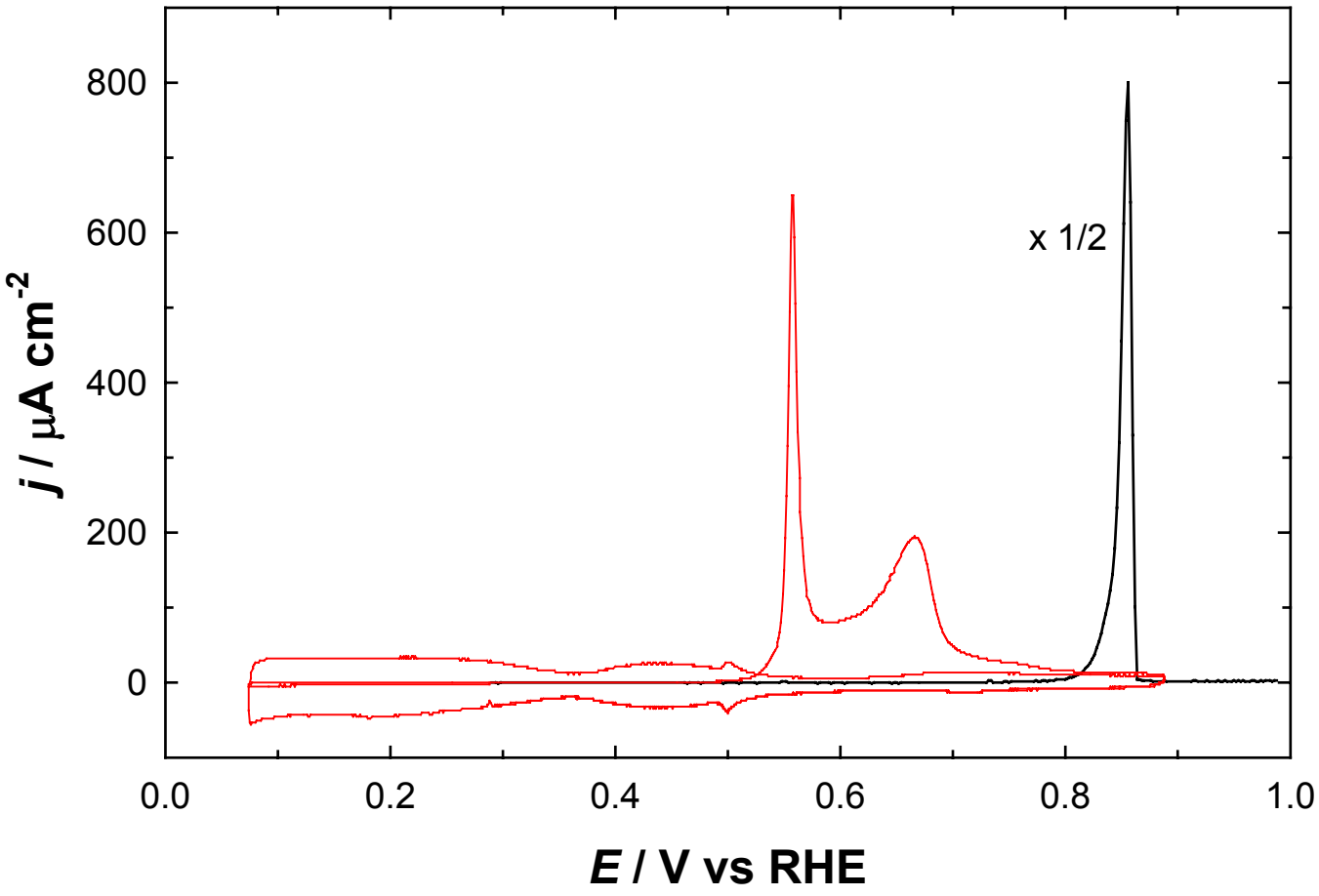
~30 times current enhancement

Enhancement in CO Tolerance by spontaneously deposited Ru onto unsupported Pt surfaces

CO stripping of CO ex MeOH



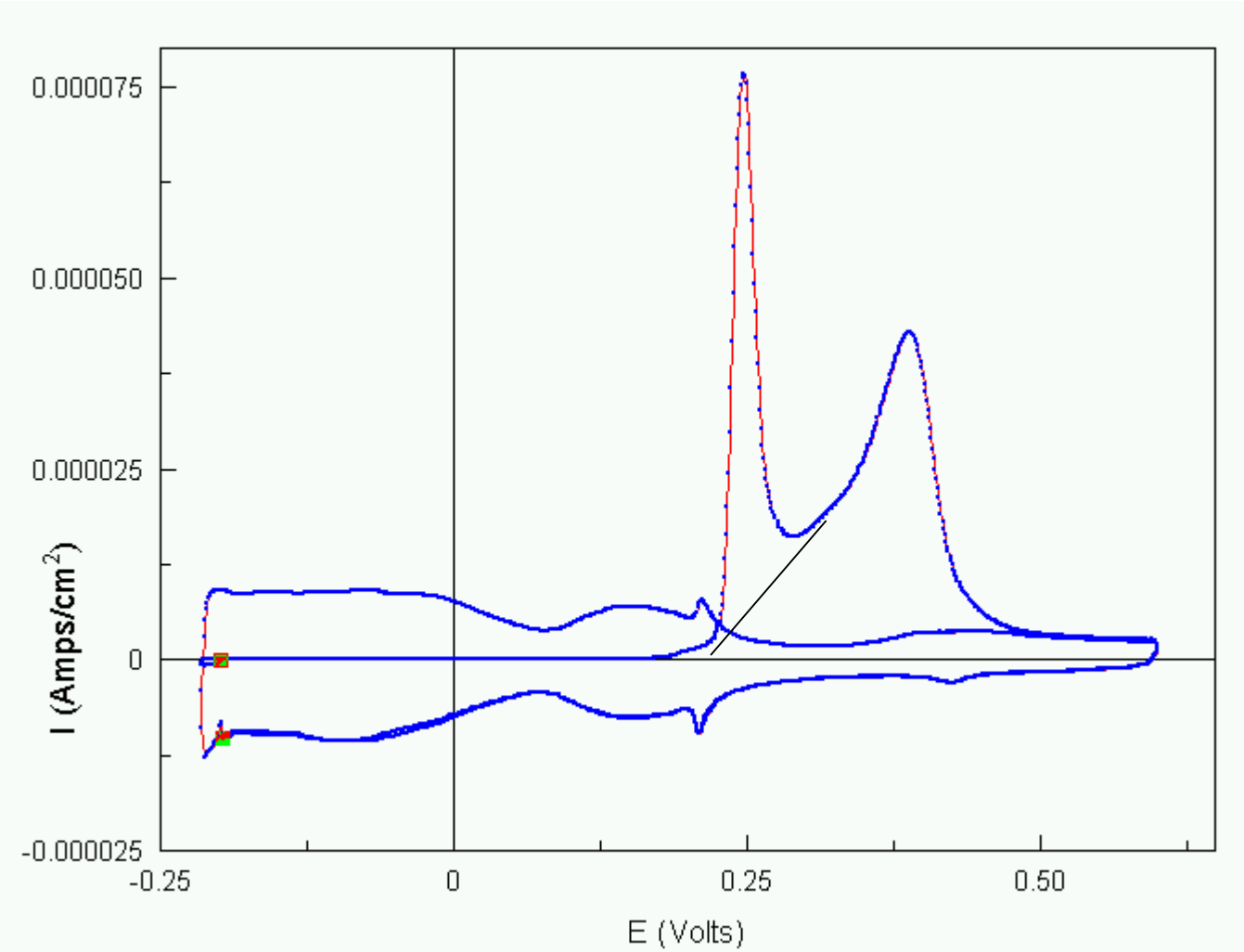
Significant potential shift!



CO dosing 5 min, Ar purging 20 min @ 0.288 V, 0.1 M H_2SO_4, 50 mV S^{-1}.

CO stripping from Pt(111)/Ru

0.1 M H_2SO_4, 50 mV/s



CO Removal on Nanoparticles

0.5 M H_2SO_4, 0.3 mV s^{-1} sweep rate